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Your reference KSW/RTB/38732

Patent application number *(The Patent Office will fill in this part)* 0402119.2

Full name, address and postcode of the or of each applicant *(underline all surnames)*

James Richard John DUKE
Ham Road
Sidlesham
Chichester
West Sussex PO20 7NY

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

08738031001

Title of the invention MILKING EQUIPMENT

Name of your agent *(if you have one)*
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

BARON & WARREN
19 SOUTH END
KENSINGTON
LONDON
W8 5BU

Patents ADP number *(if you know it)* 281001 ✓

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I/We request the grant of a patent on the basis of this application.

Signature Baron & Warren **Date 29—01—04**

BARON & WARREN
Agents for the Applicant

Name and daytime telephone number of person to contact in the United Kingdom **Keith S Warren 020 7937 0294**

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MILKING EQUIPMENT

The present invention relates to milking equipment and, more particularly, to a shut-off valve device for prohibiting the ingress of fluid, which is used to sanitise and/or cleanse the teats and teat cups post-milking, from entering a milk tube or line and contaminating the harvested milk.

Conventionally, automatic milking equipment includes a cluster of teat cups for connecting the equipment to the teats of an animal to be milked. In the case of cows, each cluster has four teat cups. Each teat cup comprises a hollow shell supporting a flexible liner which, at the upper end of the cup, has a head portion with an opening through which a teat is engaged with the cup and the liner. At the opposite, discharge end of the cup, the liner communicates with a short milk tube connected to a, so-called, claw piece of the cluster, where the milk from the animal is collected and delivered, via a long milk tube, to the collection chamber of the equipment. Milking is achieved by automatically and alternately applying vacuum and pressure pulses to the space between the shell and the liner in order to flex the liner and stimulate discharge of milk from the teat. The claw piece serves as a distributor for distributing the pulses to the individual teat cups via pneumatic lines. The milk discharged from the teats is withdrawn from the cups, via the short milk tubes and the long milk tube, under the action of vacuum applied to the long milk tube.

After milking, the teat cup cluster is automatically pulled from the teats and the teat cups are back flushed internally with water and compressed air.

This washing fluid is supplied to the teat cups via a flush valve connecting the short milk tube to the discharge end of the teat cup. When pulled from the teats, the cluster and ancillary components are designed to enable the short milk tubes to fall away from the centre line of the cluster so that the teat cups hang downwardly about the claw device and the washing liquid can escape through the head portions of the teat cups. Also, after milking, animals teats are typically automatically or manually dipped, sprayed or otherwise treated with a sanitising and conditioning fluid, for example, iodine or chlorohexadine and an emollient. For example, the teats may be treated automatically with a sanitising fluid injected within the liner of the teat cup. In both cases where the teats are treated with fluid and the teat cups are back flushed, there is a risk that the fluids used may contaminate the harvested milk if they are not physically prevented from entering the short milk tube.

EP-A-1 328 148 discloses a device for automatically cleansing the teats of an animal and the cups upon removal of the teat cups from the animal, subsequent to milking, and for physically prohibiting the ingress of the cleansing fluids into the associated short milk tube and contaminating the harvested milk. It comprises a valve device which is fitted in place of the conventional flush valve connecting the discharge end of the teat cup to its short milk tube. This valve device has a valve member slidable transversely to a valve passageway coupling the teat cup to the short milk tube so as to shut off fluid flow through the valve passageway. The valve member includes a nozzle which can communicate with the valve passageway for discharging

cleansing fluid through the valve passageway into the teat cup. The nozzle is in communication with an internal passageway in the valve member which is selectively connectable to a supply of sanitising fluid for cleansing the teat, as the teat cup is being removed, and water and compressed air for back flushing the removed teat cup, whilst the valve member is actuated to shut off fluid flow through the valve passageway. This valve device is complex, expensive to manufacture and is prone to being damaged by rough treatment.

It is an object of the present invention to provide an improved shut-off valve for preventing entry of treating fluid into the milk tubes, and consequent contamination of the harvested milk, when, subsequent to milking, treatment fluid is injected manually or automatically into a teat cup to cleanse the teat of an animal and/or to back flush the teat cup.

To this end, the invention consists in a valve device for shutting off fluid flow from a teat cup into a milk tube downstream of the teat cup, comprising a valve body having a milk passageway connectable at opposite ends to the teat cup and milk tube, respectively, a valve chamber in the valve body connected to the milk passageway via an opening in a wall of the passageway, a valve member in the form of a flexible membrane disposed in sealing relation between the chamber and the opening, and means for connecting the chamber to a source of fluid pressure, whereby the application of fluid pressure to the chamber extends and/or expands the membrane through the opening into the milk passageway so that it seals the passageway and shuts off fluid flow therethrough.

The invention enables a milk line to be closed between a teat cup and a short milk tube at the end of a milking cycle in order to prevent treatment fluid, which is injected into the associated teat cup for cleaning the animal's teat and back flushing the liner of the teat cup, from entering the short milk tube and contaminating the harvested milk. The operation of the invention and the selective supply of fluid pressure to the valve chamber in the valve body in order to shut-off fluid flow through the valve device may be fully automated, saving labour and allowing the operator to spend more time on premilking routines. Moreover, the invention is not prone to the problems associated with valves having slidable valve members for shutting off fluid flow through the milk tubes.

The invention also consists in milking equipment comprising a cluster of teat cups connected to the claw piece of the cluster by short milk tubes, in which each teat cup is connected to its associated short milk tube by a valve device constructed as described above.

When the invention is used with automatic milking equipment, in which a cluster of teat cups are engaged with the teats of a cow, for example, a suitable control signal can be derived from the milking equipment at the end of the milking cycle, for example, in response to automatic cluster removal. The control signal can be used to initiate a post-milking cycle in which sanitising fluid is injected into the void about the animal's teat and is transferred to the teat as the teat cup is removed. After take off, a further signal can be derived from the equipment in order to trigger a back flush unit which then flushes the

teat cup liner to remove traces of fluid and sterilise the teat cup for the next application. During this post-milking cycle, the application of fluid pressure to the valve chamber of the valve device actuates the membrane valve member to shut off fluid flow to the milk tube and prevent the treatment or cleansing fluids from entering the milk line. The cycle may be managed by suitably programmed electronics with the application of the cleansing fluids being controlled by pneumatic valves or the like.

Preferably, the membrane valve member has a cap-like shape which, in the unactuated position of the valve member, projects into the valve chamber with the cavity in the cap facing the passageway. Upon application of fluid pressure to the chamber, the cap-shaped valve member is turned inside out so as to project across the passageway in sealing relation with the wall or walls of the passageway.

The membrane valve member may be formed from elastomeric material. The valve chamber may be connectable to a source of vacuum, upon removal of the fluid pressure from the chamber, to assist in returning the membrane valve member to its unactuated position within the valve chamber.

When the teat cup cluster is removed from the teats of an animal, fluid pressure is applied to the valve devices to shut off fluid flow therethrough until back flushing of the teat cups is terminated and the heads of the teat cups hang downwardly with respect to the claw piece of the cluster so that any remaining fluid can drain through the head of the teat cup. The positioning and tensioning of the fluid supply tubes connected to the valve devices may

be designed so as to urge the short milk tubes to fall away from the centre line of the cluster and hang down with respect to the claw piece. Preventing the teat cups from falling over the claw piece ensures that any treatment fluid remaining within a teat cup drains through the head of the teat cup.

However, as a safeguard, in case a teat cup gets caught with its head uppermost, when pulled from the teat, so that treatment fluids cannot drain downwardly through the head of the teat cup, the valve device may have a drain port, controlled by a non-return valve, on the upstream side of the membrane valve member for enabling trapped fluid to drain from the space above the valve member when this is in the shut-off position. The non-return valve, which is conveniently a flap valve mounted on the valve body at the external end of the drain port, will normally be retained in the closed position, during the milking cycle, by vacuum applied through the milk line to extract milk from the teat cup. When this vacuum is removed and the shut-off valve device is actuated during the post-milking treatment cycle, the flap valve will enable most of the treatment fluid to drain from the teat cup and the valve device, through the drain port, should the teat cup not hang downwardly.

In a preferred embodiment, the shut-off valve device also includes a back flush nozzle directed into the milk passageway upstream of the membrane valve member, and means for connecting the nozzle to a source of back flushing fluid. This avoids the need for a separate back flushing device to be connected into the milk line between the discharge end of the teat cup and a shut-off device. Where a teat cup is constructed so as to inject

treatment fluid into the head of the teat liner and onto a teat engaged by the teat cup, such as described in my copending patent application No 0324647.7, the means for connecting the back flush nozzle to a source of back flushing fluid, may comprise a treatment fluid passageway connectable at an inlet end to a source of treatment or back flush fluid and, at an outlet end, to a delivery tube for supplying treatment fluid to the head of the teat cup. The back flush nozzle is connected to this treatment fluid passageway via a gravity controlled ball valve which permits back flushing fluid to flow to the nozzle when the teat cup is in the inverted position it assumes when disengaged from a teat. This ball valve will normally be retained in the closed position by vacuum applied through the milk line during the milking cycle. When the vacuum is removed and the post-milking treatment cycle begins, the valve ball, which initially falls on to its valve seat under the action of gravity, will be urged against the seat by treatment fluid flowing through the treatment fluid passageway and delivery tube to the head of the teat cup. However, after takeoff, and when the teat cup falls into its inverted position, the valve ball falls away from its seat to open the valve and enable back flushing fluid supplied to the treatment fluid passageway to flow through the ball valve and to be injected into the discharge end of the teat cup by the back flush nozzle.

The above arrangement for controlling the supply of teat treating fluid to the head of a teat cup and back flushing fluid to the discharge end of the cup may be used independently of the shut-off valve device. Accordingly, the

invention further consists in a back flushing unit comprising a body having a milk passageway connectable at opposite ends to the teat cup and a milk tube, respectively, and a treatment fluid passageway having an inlet end connectable to a source of teat treatment fluid or back flushing fluid and an outlet end connectable to a delivery tube for supplying teat treatment fluid to the teat cup, a back flush nozzle directed into the milk passageway, and valve means connecting the back flush nozzle to the treatment fluid passageway, said valve means being operable to prevent teat treatment fluid from flowing to the back flush nozzle, when the teat cup is engaged with a teat, whilst permitting back flushing fluid to flow to the nozzle when the teat cup is disengaged from the teat and in an inverted position.

In order that the present invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is a axial section through a shut-off valve device according to the invention and associated teat cup, the valve device being shown in an unactuated condition,

Figure 2 is a view similar to Figure 1 showing the valve device in an actuated condition, and

Figure 3 is a view similar to Figure 2 showing the valve device and teat cup in the inverted position which it is intended to assume after take-off.

Referring to Figures 1 and 2 of the accompanying drawings, the shut-off valve device 1 according to the invention comprises a valve body 2 having a milk passageway 3 therethrough. Opposite ends of the milk passageway

terminate in spigots 4 for coupling the milk passageway to the discharge end 5 of a teat cup 6 and a short milk tube 7 connecting the teat cup to the claw piece (not shown) of a teat cup cluster. The valve body 2 has a cylindrical valve chamber 8 to one side of the milk passageway which is connected to the latter via a circular opening 9. A valve member 10 moulded from flexible membrane material, such as, rubber, silicone or other elastomeric material, forms a seal between the chamber 8 and the opening 9. The membrane valve member 10 is moulded in a cylindrical cap-like shape having its cap portion 10a projecting into the chamber 8 and the cavity in the cap portion facing the milk passageway, when in the unactuated position shown in Figure 1. This valve member is retained in position by an outwardly projecting radial flange 12 about the mouth of its cavity trapped between interfitting parts of the valve body. The valve chamber 8 is selectively connectable to a source of pneumatic pressure or vacuum for controlling the valve member 10 via a port 13 in the wall of the chamber which has its external end connected to a pneumatic tube 14 for coupling the port to the source of pneumatic pressure or vacuum. A pressure sensor 15 monitors the pressure in the valve chamber 8 for detecting possible malfunction of the membrane valve member. A recess 11 is formed about the internal wall of the milk passageway 3 adjacent the valve chamber 8 for locating the valve member 10 when the latter is extended across the passageway in its actuated position.

Formed through the valve body generally parallel to the milk passageway 3 is a treatment fluid passageway 16 having its opposite ends

connected to a treatment fluid supply tube 17 and a delivery tube 18 for supplying the treatment fluid to the head of the teat cup 6. The fluid supply tube 17 is connected to the passageway 16 via a pressure actuated control valve 19 controlled by the fluid pressure within the tube 17, and to the delivery tube 18 via a restrictor 20 for regulating the flow ratio between the supply of treatment fluid to the delivery tube 18 and a back flush nozzle 21.

The back flush nozzle 21 is inclined to the axis of the milk passageway 3 and is connected, via gravity controlled ball valve 22, to a port 23 coupling the ball valve to the treatment fluid passageway 16. The ball valve 22 comprises a valve chamber 24, a valve ball 25 and a valve seat 26. The valve seat is connected to the back flush nozzle 21 via the valve outlet port, and the valve chamber 24 is connected to the port 23. The valve ball is freely movable within the valve chamber 24.

Formed through the wall of the valve body 2 opposite the back flush nozzle 21 and immediately upstream of the location recess 11 in the internal wall of the milk passageway is a drain port 27 for enabling fluid trapped by the shut-off valve to drain from the valve. This port is controlled by a non-return flap valve 28 mounted on the valve body at the external end of the drain port 27.

The spigot 4 at the inlet end of the milk passageway 3 is an interference fit in the discharge end 5 of the flexible liner 29 of the teat cup 6 in order to couple the valve device to the teat cup. By way of example, the teat cup 6 illustrated in the drawings is constructed as described in my

copending patent application No 0324647.7 and comprises the liner 29, a hollow shell 30, which surrounds and supports the flexible liner, and a nozzle 31 for injecting teat treatment fluid into the head 39 of the liner and onto a teat engaged by the cup. The nozzle 31 is connected to a source of treatment fluid by the delivery tube 18, the treatment fluid passageway 16 and the supply tube 17. Because the treatment fluid is injected into the head of the liner 29 prior to removal of the cup from the teat, the teat is coated immediately after milking, giving protection before the teat is exposed to the environment, and the treatment fluid is wiped down the teat as the teat cup is removed.

Each teat cup 6 of a milking cluster is fitted with a shut-off valve device 1 between its discharge end 5 and the short milk tube 7 connecting the teat cup to the claw piece of the cluster. The claw piece serves to distribute air, vacuum and treatment fluid to the tubes 14,17. When the teat cups are attached to the teats of a cow for milking, the teat cups are generally in the position illustrated in Figures 1 and 2, with their heads 39 uppermost. Milking is stimulated by automatically and alternately applying vacuum pressure pulses to the space between the shell 30 and the liner 29 of each teat cup, via a suitable pneumatic line (not shown) served from the claw device. During the milking cycle, the valve device 1 is in the open position, as illustrated in Figure 1, and milk is extracted from each teat cup via the associated valve device and the short milk tube 7 by vacuum applied through the claw device. This vacuum retains the non-return flap valve 28 in the closed condition so

that milk cannot bleed through the drain port 27. The valve ball 25 of the ball valve 22 initially falls, under the action of gravity, onto its valve seat 26 and is also retained in this position by the vacuum so that the ball valve is closed and prevents the ingress of milk into treatment fluid passageway 16. At this stage, there is no supply of teat treatment fluid to the supply tube 17, the pressure valve 19 is closed and the membrane valve member 10 is in the unactuated position shown in Figure 1.

Upon termination of the milking cycle and automatic initiation of the fluid treatment and take-off cycle, fluid pressure is supplied to the pneumatic tube 14 to actuate the membrane valve member 10. As illustrated in Figure 2, upon the application of pressure, the valve member is turned inside out so as to project across the milk passageway and is expanded or inflated so as to seal with the recess 11. This blocks the milk passageway 3 and shuts off fluid flow therethrough. The pressure sensor 15 connected to monitor the membrane valve member 10 senses whether or not the valve member has operated correctly. If it has not, the associated milking cluster will be shut down in conjunction with the actuation of an alarm. Thereafter, teat treatment fluid is introduced under pressure into the fluid treatment tube 17. It opens the pressure valve 19 and flows through the restrictor 20 into the head 39 of the liner 29 via the nozzle 31, which applies the treatment fluid to the animal teat for a predetermined period. During this period, the valve ball 25 is held on its seat by the fluid pressure to prevent the treatment fluid being injected through the back flush nozzle 21. Because vacuum is no longer applied,

when the pressure in the milk passageway 3 above the extended membrane valve 10 returns to atmospheric pressure, the flap valve 28 is free to open. This provides the facility for any fluid to drain away, if the teat cup is prevented from falling over upon take-off and is held in a partially upright position. The injection of treatment fluid, via the nozzle 31, is continued as the teat cup 6 is withdrawn from the teat and is wiped down the treat as the teat cup is removed. When the supply of treatment fluid to the nozzle 31 is terminated, the valve ball is no longer urged onto its seat by the fluid pressure and is free to move within the valve chamber.

As the teat cup 6 is removed from the teat upon take-off, the milking cluster is designed so that the teat cup naturally falls, together with the short milk tube 7, into an inverted position, with its head downwardly, as illustrated in Figure 3. The valve ball 25 is free to move from its seat 26 under the action of gravity, as the teat cup is inverted, and the ball valve 22 is opened. After a predetermined time delay, back flushing liquid is injected into the supply tube 17, valve 19 is lifted off its seat, and this liquid flows through the open valve 22 to the back flush nozzle 21 which injects the liquid into the inside of the liner 29 to clean the latter. A portion of the back flush liquid is allowed to flow past the restrictor 20 and flush clean the delivery tube 18 and treatment nozzle 31. Clean compressed air is then injected through the tube 17 to dry the liner, delivery tube and nozzle. It will be apparent that the ball valve 22 is so constructed that, if the teat cup falls in an unintended way on take-off and ends up laying across the claw piece of the milking cluster, the valve ball 25 is

still dislodged from its seat to allow the back flush fluids to flow through the valve to the back flush injector nozzle 21.

When the back flushing operation is terminated, vacuum is applied to the tube 14 in order to return the membrane valve into the valve chamber 8 and open the shut-off valve. After take off, it is also standard practice to position the cluster of teat cups in an inverted position on a cleaning jetter so as to thoroughly wash the milk tubes by circulating cleaning liquid through the tubes. The cleaning liquid is drawn into each teat cup 6 by the vacuum system of the milking equipment, washing the liner 29 and membrane valves 10 internally. Also, the system vacuum causes the cleaning liquid to enter the nozzle 31 and flow through the delivery tube 18 to exit via the ball valve 22 and back flush nozzle 21, the valve ball 25 being held open by gravity as this washing takes place.

Whilst a particular embodiment has been described, it will be understood that modifications can be made without departing from the scope of the invention. For example, the valve body 2 may be close coupled to or be integral with the shell 30 or the claw piece.

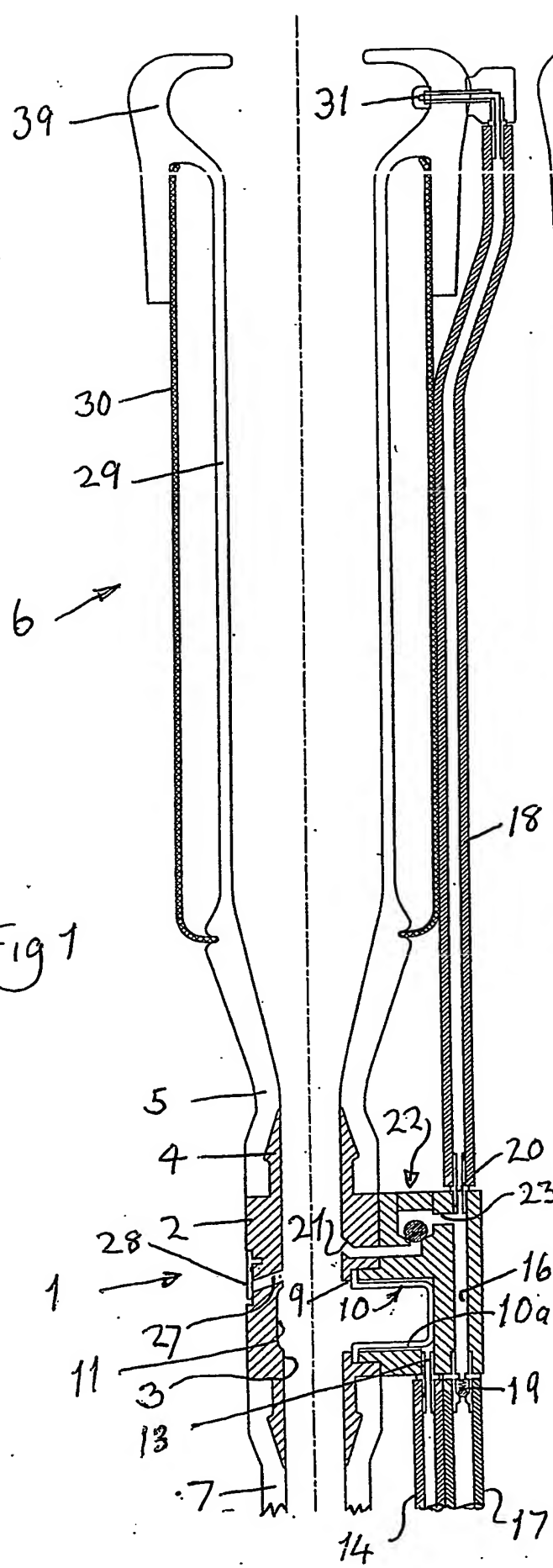
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Fig 1

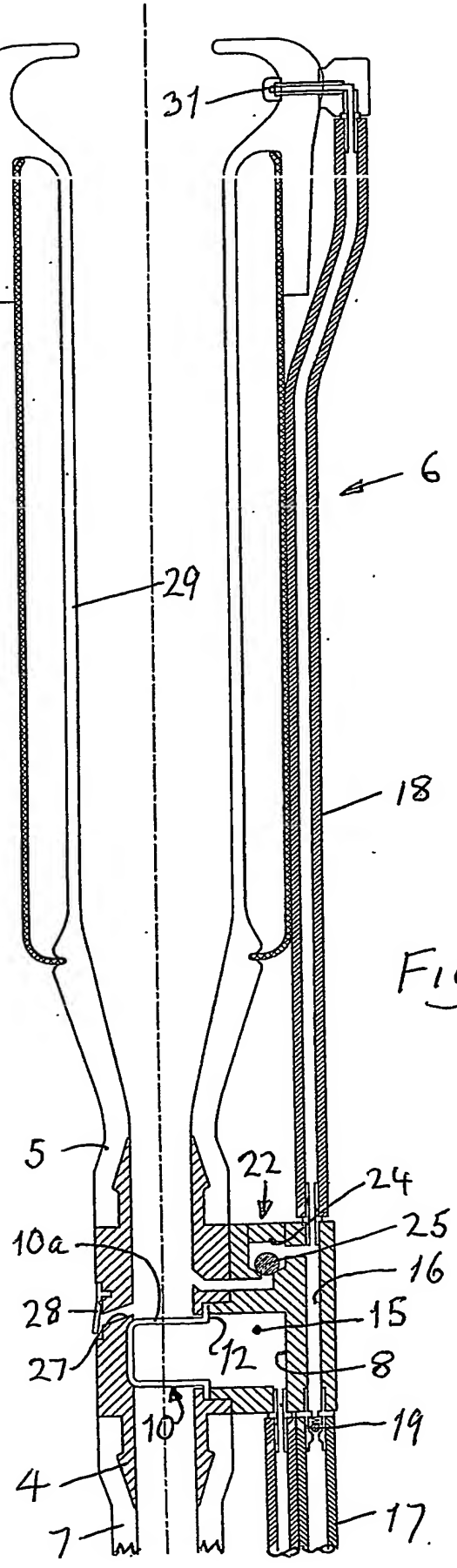
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Fig 2

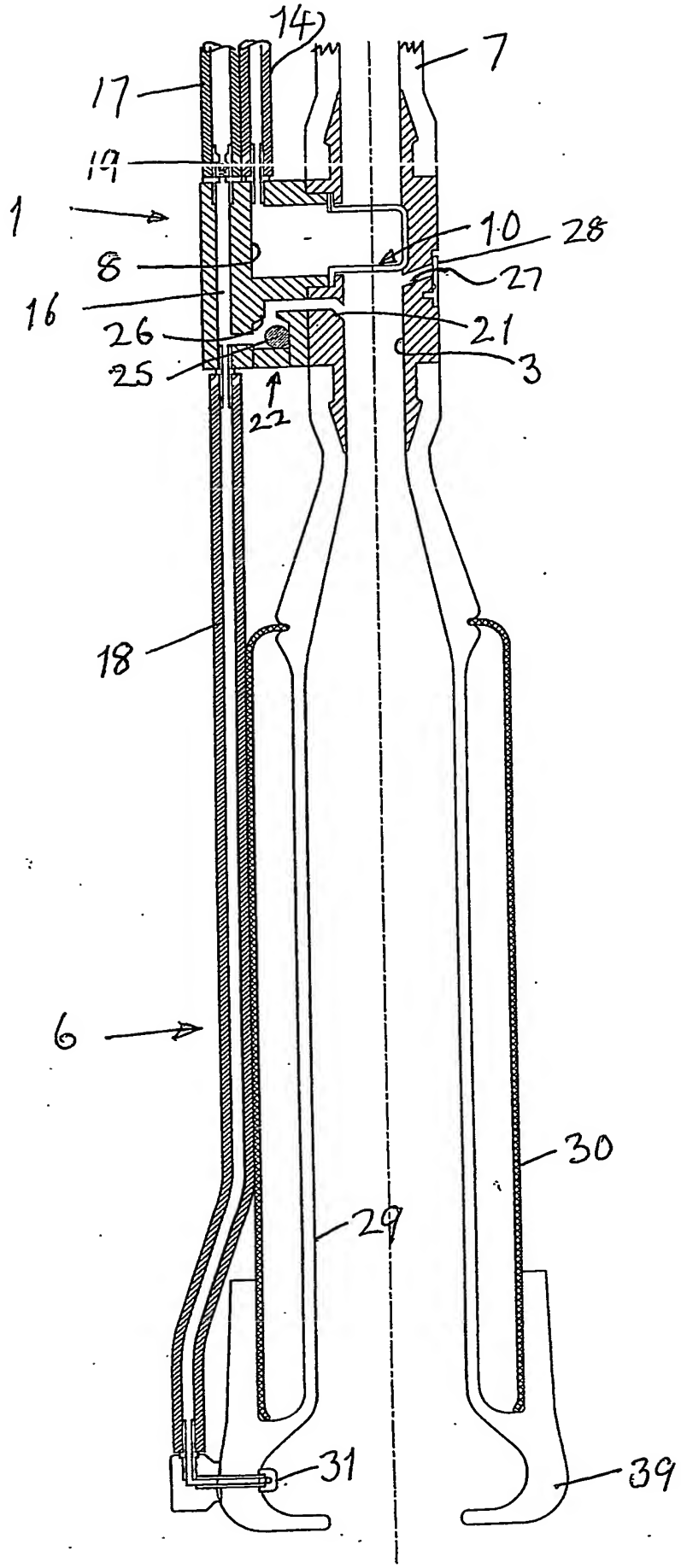

Fig 3